Chapter 7
E–Learning with Affective Tutoring Systems

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ABSTRACT
E-learning has attracted a great deal of interest in educational circles from K-12 to universities. A question that is often rightly asked is how effective current e-learning systems are. It is argued that there is little individualization of instruction by adapting to the pedagogical needs of each learner in current e-learning systems. Intelligent tutoring systems have tried to fill this gap but even they fail to compete with human one-to-one tutoring. This paper presents Affective Tutoring Systems which are e-learning systems capable of detecting learners’ affective state and reacting to it through a life like agent called Eve. This paper presents an Affective Tutoring System in the domain of mathematics and the research that led to its development. It also presents the findings from the study and testing of the system indicating that the animated agent Eve carried a persona effect.

INTRODUCTION
Using computers in education is a topic of great interest in today’s schools and universities as well as the e-learning market. The global e-learning market is projected to exceed $52.6 billion by 2010 (Kopf, 2007). Due to the paucity of recently published literature containing empirical data on the effectiveness of e-learning, many are (rightly) asking: “Are computers being used as effectively as they could be for education?”

In fact, e-learning has been a significant issue since before desktop computers were invented, with the work of the American psychologist B.F. Skinner, who used “teaching machines” to present and assess basic flashcard exercises (Hill 1997). As technology improved, computers replaced the teaching machines, and Computer Assisted Instruction (CAI) came into being (Hayes 2001).
What CAI systems lacked, however, was a means of individualizing instruction by adapting to the pedagogical needs of each learner (Urban-Lurain 2003). This meant that all students were instructed in exactly the same way, and the strengths, weaknesses, and learning styles of individual students were rarely considered.

The successor to CAI was the Intelligent Tutoring System (ITS), which came into existence during the early 1970s and is still in vogue today. ITSs are characterized by the ‘intelligent’ ability to adapt their teaching strategies to the knowledge and abilities of individual learners. This is so that the instruction is as effective and efficient as possible (Urban-Lurain 2003). ITSs represent a significant improvement over CAI systems. They have proven to be effective, resulting in increased learning (Aleven et al. 1999; Aleven & Koedinger 2001; Anderson et al. 1995; Conati & VanLehn 2001; Mitrovic et al. 2002; Whitehurst et al. 1998). Studies have shown that ITSs even outperform traditional classroom instruction: they are always available, non-judgmental and provide tailored feedback (Anderson et al. 1995; Holt et al. 1994; Johnson et al. 2003; Self 1990). Even so, we assert that one-to-one human tutoring remains the most effective means of instruction, and would, were enough tutors found to teach and enough money found to pay them, quite certainly provide the best solution. There are, however, some characteristics of human tutors that are not optimal. First, human tutors are typically not available at the convenience of the student. Rarely does one find a human tutor who is available 24/7 and ready to go at a moment’s notice. Secondly, human tutors become tired and fatigued. Most human tutors are good for 1-2 hours at best, and after that are not at their best from either personality or performance perspectives. Finally, unless providing services pro bono, human tutors are beyond the reach of many students of limited means. So, the ultimate aim of an ITS – to create a tutor as effective and efficient as a human, but without the human cognitive and emotional weaknesses or often, great expense.

If human tutors are the “ideal” solution from a learning perspective, however, what are the capabilities of humans that machines lack? For example, human tutors can perceive the cognitive and emotional state of the human learner in real time, and adjust their pedagogical approach according to this perception. Is it reasonable to suggest that we could embed these naturally occurring perceptual characteristics of human tutors into an ITS? We believe that the answer is “yes”, and have evidence to support our assertion (Sarrafzadeh et al., 2008). We outline our rationale and approach in the following sections. This paper, presented in five sections, covers various aspects of affective tutoring systems (Alexander, Sarrafzadeh, Hill, 2008) and how they can improve e-learning.

THE SIGNIFICANCE OF AFFECT IN E-LEARNING

Why is it that computer based tutoring systems are generally less effective than one-to-one human tutoring? Overmyer (Overmyer 1999) asserts that today’s ITSs lack the ‘personality’ of human tutors, which greatly reduces their ability to adapt to the precise needs of each individual learner. In fact, studies show that 35% of comments by human tutors have affective content (Self 1990), and estimate that a staggering 93% of affective communication takes place either non-verbally or paralinguistically (Mehrabian, 1971), through facial expressions, gestures, or vocal inflections (Picard 1998). Yet, nearly all existing ITSs adapt their teaching strategies based only on a model of the cognitive state of the learner (i.e., the state of learner knowledge). Naturally, human tutors do this too, but good human tutors also regulate their teaching strategies based upon the non-verbal (including affective) feedback given by the learner, which tells the tutor whether the learner is happy, confused, frustrated, surprised, bored, or content with the material that the tutor is presenting. For example, a human tutor who can see that a learner
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